THE DISTRIBUTION AND HABITS OF *ALOPIA*, A SUB-GENUS OF *CLAUSILIA*.

By the Rev. A. H. Cooke, M.A., F.Z.S.

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The sub-genus *Alopia* was first constituted by H. & A. Adams in 1858 for a group of dextrorsal *Clausilia* inhabiting Transylvania. The description given in Adams is a word-for-word translation of Charpentier's characterization of his section[1] in his grouping of *Clausilia*,[2] but the French author gave no sub-generic names to his sections. Both authors grouped only three species under *Alopia*, viz., *Bielzi*, Pfr. (Parr.), *Lischkeana*, Parr., *pruinosa*, Parr., while they placed several other species now reckoned as *Alopia* (e.g. *plumbea*, Rossm., *straminicollis*, Parr., *canescens*, Parr., *regalis*, Parr.) under another section.

Two discoveries caused the subsequent enlargement of the sub-genus. In the first place it was observed, by E. A. Bielz and others, that several sinistral species were also to be grouped under *Alopia*, and, secondly, Adolph Schmidt pointed out[3] that the so-called *Balea* or *Baleo-Clausilia* of the Southern Carpathians were also *Alopia*, and that the absence of a clausilium was no true ground for separating them sub-generically, a view stoutly contested by E. A. Bielz.[4]

My object in the present paper is not so much to attempt to settle disputed points of classification or identification, as to record the impressions I have myself received from two visits paid to Transylvania in the autumns of 1909 and 1911, with the special purpose of observing the habits, mode of life, and distribution of the group.

1. *Distribution.*—The *Alopia* group is entirely peculiar to Hungary and the part of Roumania immediately adjacent. More than this, of the seventy-two species, sub-species, and varieties enumerated by Kimakowicz,[5] seventy-one are found in the south-east corner of Hungary known to us as Transylvania, and to the Austrians as Siebenbürgen, and on the Roumanian slope of the adjacent Carpathians. More than this still, of these seventy-one, sixty occur within a radius of 40 km. from Kronstadt (Hung. Brassó), which town, lying as it does at the foot of the Carpathians, and only 13 km. as the crow flies from the Roumanian frontier, may be regarded as the nucleus of the group. And further, if a circle be described with Kronstadt as the centre, and radius 40 km., and a diameter be run across this circle from east to west, of the sixty species, sub-species, and varieties living within the circle, six only occur to the north of the diameter and fifty-four to the south, a sufficient indication that *Alopia* is essentially a mountain-dwelling group.

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[1] *Genera*, vol. ii, p. 181.

[2] Journal de Conchyliologie, sér. 1, vol. iii, p. 361, 1852.

[3] Syst. Europ. Clausilien, 1868, pp. 3, 4, 18–28; Zeitsch. Ges. Naturwiss., vol. viii, pp. 407–13, 1856.

[4] *Fauna der Land- und Süsswasser-Mollusken Siebenbürgens*[2], 1867, p. 103.

[5] Verh. Siebenbürg. Ver., vol. xliii, pp. 19–58, 1894.

On the main chain of the South Carpathians the range of the group is sharply defined. It is not found west of the Königstein, or east of the village of Bodza-vama, at the foot of the Czukás and the Dobromir. In other words, it inhabits about 65 to 70 km. only of the main chain. The highest peaks of the range stretch unbroken westward of the Königstein, but at the Königstein *Alopia* stops dead, to appear once more, in a single species and two varieties, 150 km. to the west, near the Szurduk Pass into Roumania.

2. *Locality.*—Within these limits *Alopia* occurs exclusively in the Jurassic, Cretaceous, and Eocene limestones. It is essentially a rock-haunting group; in vain will you look for it on trees, or on mossy banks, or amongst nettle-roots, or under stones, or in any of the localities affected by the ordinary British or Continental *Clausilia*. The open mountain ridges, the perpendicular cliffs, the huge boulders which have become detached from the precipices, are its chosen home, and it occurs nowhere else. Quite exceptionally I have found a few specimens of *Meschendörferi*, Bielz, on tree trunks growing close to great boulders, but this was under circumstances which made it crawl about in a state of excitement, and *plumbea*, Rossm., may be found on old walls in Kronstadt itself. But one soon learns the lesson that it is waste of time to look for *Alopia* on any mountain within the favoured area, unless that mountain contains bare faces of limestone cliff; if these occur, it may be predicted with some certainty that *Alopia* will be present also.

The great limestone range of the South Carpathians is cut into deep and precipitous valleys. These 'Schluchten', the sides of which often rise in cliffs 500 to 1,000 feet high, and are sometimes so narrow that you can almost touch both sides with outstretched arms, are invariably tenanted by *Alopia*, and the same species will often vary considerably, e.g. in the upper and lower ends of the same 'Schlucht'. How variable the group is, is shown by the fact that Kimakowicz only recognizes fourteen species and sub-species, while he enumerates fifty-eight named varieties.

It is remarkable within what narrow limits a species or a definite variety will occur. I will give some instances of this. Bielz[1] describes *A. Meschendörferi* as occurring exclusively on the Zeidnerberg, a somewhat isolated mountain about seven miles from Brassó. In 1909 I went up the Zeidnerberg with the object of collecting this species. On the ascent I searched for it in every possible locality without any success. I arrived within two minutes of the top without having secured a single specimen, and seriously thought I must have climbed the wrong mountain. Suddenly, on a low piece of exposed rock face, the species appeared in abundance, and it is no exaggeration to say that, for the remaining 50 feet, if I had wanted a thousand living specimens, I could easily have taken them.

The Great and Little Königstein are separated by a narrow and steep Schlucht called the Krepatura. On the perpendicular sides of the Schlucht *A. Fussiana*, Bielz, var. *insignis*, a sinistral form with

[1] *Fauna der Land- und Süsswasser-Mollusken Siebenbürgens*, p. 127.

well-marked riblets, occurs in fair abundance. When you get to the top of the Krepatura, you step over a little saddle, perhaps 40 feet wide, and descend equally steeply on the other side. The moment you get to the top, *A. Fussiana*, var. *insignis*, stops dead, and is replaced on the rocks of the Schlucht on the other side by a dextral form, *A. Fussiana*, var. *pruinosa*, Parr.

A. Bielzi, Pfr., var. *Potaissanensis*, Kim., occurs only in the Schlucht of Torda, and I made a special expedition to Torda to obtain it. The Schlucht, whose perpendicular limestone sides appeared most favourable for the occurrence of *Alopia*, was searched from one end to the other without the slightest success. At last, when almost giving up the search in despair, one came upon it in abundance on a certain buttress of steep rock, but, search as one might on both sides of the Schlucht, not a single specimen was found except on this patch of rock, which measured no more than 30 feet in length, and apparently differed in no respect from neighbouring patches.

But the Donghavás mountain is perhaps more remarkable than any for its breeding of varieties. It is a round, stumpy mountain of about 5,000 feet, covered with forest, and with streaks of limestone cliff on all its faces. Kimakowicz enumerates five distinct varieties of *Alopia* from different sides of the mountain, and all peculiar. I cannot pretend to have found all these, but I found three forms of the same species wholly distinct from one another, each occurring within sharply defined limits. Not half a mile from the Donghavás rises another mountain, the Tésla, also round-topped, covered with forest, and with streaks of limestone cliff. On the Tésla cliffs an *Alopia* (*glauca*, Bielz) occurs, entirely distinct from anything in the Donghavás, and scarcely varying at all, while *A. Haueri* on the Donghavás has five separate varieties.

Alopia elegans, Bielz, a very well-marked species, is confined to the Dumboviciora Schlucht in Roumania, on the far south side of the Königstein. Two good varieties are found in the upper part of the same Schlucht, *cerasina*, A. Schm., and *intercedens*, A. Schm.

Although the species and varieties are so numerous, and although the area over which the majority of the group occurs is relatively so small, the species never overlap. No two distinct species ever live together on the same cliff face. So far as external features go, the Malajester, Propasta, Bogater, Dumboviciora Schluchten appear equally adapted for the habitation of *Alopia*, and yet each has its one species and no more, the Malajester *livida*, Menke, the Dumboviciora *elegans*, Bielz, the Bogater *Bogatensis*, Bielz, the Propasta *Lischkeana*, Parr., the Krepatura *Fussiana*, Bielz, var. *insignis*. In the two latter cases, the Schluchten in question form part of the same mountain, which is not of great area, and open on to the plain at no great distance from one another.

These restrictions of locality perhaps do not stand alone and could be paralleled by similar instances in other genera. But what makes them more remarkable in this case is, that many other forms of *Clausilia*, not being *Alopia*, occur abundantly all over the district, with no such restrictions of distribution, and no appreciable tendency

to extremes of variation. Thus, of the *Alinda* group, *critica*, Bielz, *fallax*, Rossm., *stabilis*, Zieg, are found everywhere, and the same is the case with *cana*, Held, and *plicata*, Desh. (*Laciniaria*), *marginata*, Zieg, *transsylvanica*, Zieg, and *orthostoma*, Menke (*Marpessa*), *latestriata*, Bielz, and *dubia*, Drap. (*Iphigenia*). Some of these forms occur wherever an *Alopia* is found (I have a specimen of *cana* from the top of the Butschetsch, 8,230 feet), and they are spread impartially all over the district.

3. *Habits of Life and Food.*—One notices that though all Alopias live on limestone rocks, and nowhere else, there are certain differences of method in the various species. In the Krepatura, *A. Fussiana*, var. *insignis*, is scattered in ones and twos on the perpendicular face of the cliff, and seldom packs closely together. On the Donghavás, *A. Haueri*, var. *ambigua*, has similar habits, and a closely related form from the Czukás is scattered over rocks, showing a special predilection, which I have noticed in other groups, for bands of moist clay. On the Tésla, *A. glauca* does not gather gregariously in cracks or holes, but stands out singly on the face of the rock. The same is the case with *livida* in the Malajester Schlucht, and with a form of whose exact identity I am not quite certain, found on the Furnica in Roumania. On the other hand, *A. Fussiana*, var. *pruinosa*, from a similar locality to the east of the Königstein, fairly astonished me by its propensity for clotting together in masses at the foot of the cliffs close to the ground. I first found a bunch of twenty-seven, then another of sixty, and finally measured a space 2 feet long by $2\frac{1}{2}$ inches high, and counted on it over 200 living specimens, all adult. *A. Meschendörferi*, on the Zeidnerberg, gathers in bunches in the hollows of the limestone. On the top of the Piatra Mare *A. canescens* is fairly abundant, but if you look on the rock faces you will hardly find a single specimen, even in the shady cracks; the species occurs half buried in the grass at the foot of the rocks and under ledges which are almost flush with the ground.

The food of *Alopia* is, as a rule, minute mosses and lichens. There is no doubt that the microscopic algæ and vegetable organisms occurring on the disintegrated limestone surfaces are also eaten by them. On the conglomerate it can only find moss and lichen. I have never found one on a green leaf.

4. *Variation in Size.*—When large numbers of a given species are examined, specimens will generally be found of a large and also of a small form, in each case fully grown. The fact is very marked in the case of *livida* from the Malajester Schlucht, *glauca* from the Tésla, *Haueri*, var. *ambigua* from the West Donghavás, *plumbea* from near Kronstadt, *Fussiana* from the Königstein. In each of these cases the larger form sometimes contains two whorls more than the shorter, and the shell appears much finer and more fully developed. It seems probable that this difference in size is not due to any cause marking an optimum or pessimum of locality, or to any distinctions in the conditions of food supply. One is more inclined to support a view[1]

[1] Küster, *Die Binnenconchylien Dalmatiens*, p. 10.

which refers the difference to causes purely mechanical. A long spiral shell which is accustomed to live and grow without support is likely to become produced in the spire, purely by the operation of its own weight, while a shell which is to a certain extent supported, or at all events which has not to bear the continual downward pull of its own weight, would not exhibit this tendency to become produced. It follows that shells which creep habitually upon the surface of perpendicular rocks will tend to be, as a rule, longer than shells of the same species which creep on the level, or on a surface approaching the level, where the effect of weight is not so pronounced. That this actually occurs I have noticed in the cases mentioned above, particularly in that of *livida*, Menke, where specimens taken from boulders in the Malajester Schlucht were appreciably smaller than specimens from the perpendicular cliffs which rose a few score yards away.

5. *Derivation of the group.*—One is tempted to indulge in speculations as to where the origin should be looked for of this interesting group, which, from the absence of a clausilium in some of its species, and its instability in others, appears[1] to be a survival of a stage in the development of *Clausilia*, whose nearest relatives must be sought for in groups now extinct and represented only by fossil or sub-fossil forms. It seems quite clear that the group, as it is now represented, originated high up on the mountains,[2] and did not climb up into them from the plain. One is led to this conclusion by observing that when the conformation of a mountain admits of it, a species descends low; where it does not, it remains high up. Thus, *A. livida*, Menke, *begins* at about 200 feet below the Schutzhütte in the Malajester Tal, that is, at about 5,000 feet, and continues up to the top of the Butschetsch (8,230 feet). It comes no lower, because the great boulders and cliffs cease in that Schlucht at about 5,000 feet, and it cannot live except on these. On the other hand, the forms characteristic of the Propasta and the Krepatura (*Lischkeana*, Parr., and *Fussiana*, Bielz, var. *insignis*) almost reach the level of the plain near Zernest (about 2,000 feet), because the Schluchten in which they live spring almost from the plain itself, and they have thus been able to descend the mountain to the lower level. The most striking instance of this is *plumbea*, Rossm., which occurs all over the Schuler (5,900 feet), the nearest mountain to Brassó, but it is also found on the walls of Brassó itself (1,800 feet), because (1) there occurs between the Schuler and Brassó a series of cliff faces and rocks, never separated by a very distant interval, and (2) the species seems to have accustomed itself, more than any other of the group, to living on smaller rock-faces and smaller boulders.

Questions relating to the validity and relationship of the various species and varieties will be dealt with in a further paper.

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[1] Boettger, *Clausilienstudien*, pp. 6, 24.

[2] Kimakowicz is bold enough to regard the Czukás and the Butschetsch Mountains as the two original homes of the parent stock or stocks.